

Case study

# Modernizing electric grid services with private LTE

NRTC broadens digital electric grid coverage and capacity with private LTE





# Enabling electric co-ops to support more advanced smart grid use cases

**Trial Results:**  
National Rural Telecommunications Cooperative

**Industry:**  
Utilities

## Executive summary

The National Rural Telecommunications Cooperative (NRTC) helps its member cooperatives bring advanced electric service capabilities to its member communities on par with investor-owned utilities serving urban population centers. Modern electric systems require advanced communications networks to enable many new applications, and NRTC is partnering with Ericsson to design a model private Long Term Evolution (LTE) network for NRTC's members to support this new generation of smart grid applications and services. LTE is a 4th generation 3GPP wireless communication standard that enables radio networks to support new types of traffic and more advanced use cases than previous generations by providing higher throughput and lower latency. With a standardized technology like LTE, a wide ecosystem of end devices or 3GPP user equipment are possible. The model private LTE network developed for NRTC uses Ericsson's radio, core, and

network management technologies to provide a platform for advanced bi-directional grid communications. This provides NRTC's members with the ability to customize and deploy a network to achieve secure, long-range wireless connectivity necessary to enable smart grid use cases for the digital grid and transactional energy. West Kentucky Rural Electric Cooperative Corporation (WKRECC) and NRTC recently conducted a successful trial with Ericsson, deploying a private LTE network based on the model network, customized for WKRECC's specific needs. In the trial, the private LTE network delivered dramatic performance improvements for WKRECC's supervisory control and data acquisition (SCADA) systems. More broadly, private LTE is viewed as a means to provide increased grid resilience, safety, security, and flexibility, with far-reaching economic impact for NRTC's members.

## At-a-glance

### Goal:

Empower electric cooperatives to support more advanced smart grid capabilities through affordable private LTE networks

### Approach:

- Partner with Ericsson to design an affordable modern 3GPP-standardized private LTE network solution based on Ericsson radio technologies
- Conduct an extensive trial with WKRECC to prove the value of private LTE for smart grid use cases
- Provide advisory services and technical resources to help electric co-ops plan and deploy private LTE networks
- Demonstrate the capability of private LTE to serve suburban and rural communities with fixed wireless access internet services

### Results:

- Successfully trialed private LTE at WKRECC for a range of smart grid use cases such as SCADA, push-to-talk applications, fixed wireless access, and narrow-band IoT
- Demonstrated capability of private LTE to support multiple smart grid systems for a fraction of the cost compared to expanding just one system
- Achieved a throughput of 13 Mbps download/5 Mbps upload speeds and latency of just 80 milliseconds from Kentucky to a hosted core application server in Texas
- Successfully executed LTE mobility handovers in field testing with push-to-talk handsets and over-the-top applications, leveraging the 3GPP user equipment ecosystem and demonstrating private LTE's capabilities for work force mobilization and enablement
- Demonstrated office LAN application uses cases using on-premises fixed wireless equipment that achieved throughput up to 90Mbps downlink and 11Mbps uplink over a distance of two miles
- Showed the viability of fixed wireless access with private LTE and the possibility of achieving higher throughputs by using multiple LTE carriers aggregated together

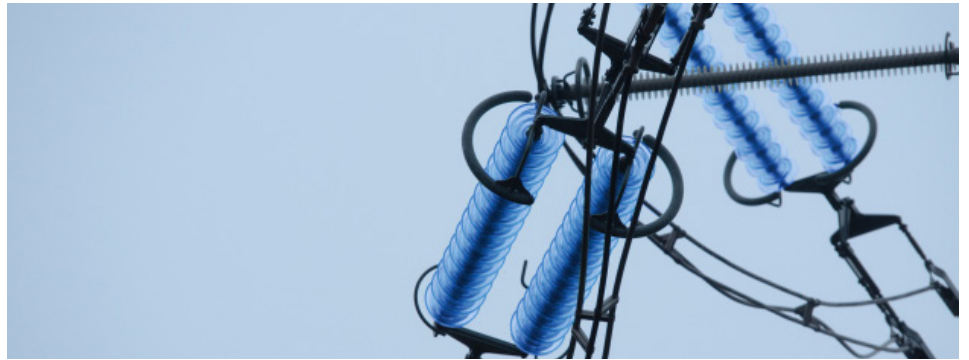
## Accelerating modernization of electric systems

Electric cooperatives have brought great prosperity to their communities for the last century since Congress passed the rural electrification act in 1936. However the same grid that brought electric power to homes, farms, and businesses across the United States is in need of upgrade as older technologies are coming to end-of-life and will struggle to meet the demands brought by transactional energy and the digitization of the electric grid. Underpinning all of that is the need for a modern communications infrastructure brought by standards-based network technologies such as LTE.

Joe Walsh, NRTC's vice president of smart grid advisory and networks, says, "Our goal is to help our members implement technology to address changing grid dynamics and that requires a modern standards-based communications network such as private LTE. We're helping our electric cooperatives understand how the electric grid is changing, what the impact will be on them, and how to choose the right technology solutions to best serve their members, including modern standards-based communications networks such as private LTE."

# 60X

Wider spectrum for future advanced metering infrastructure to enable a single network to provide advanced metering capabilities such as voltage optimization, power quality monitoring, time of use rates, disaggregated load measurement, etc.



### Enabling electric utility co-ops to maximize smart grid opportunities

NRTC is focused on maximizing the opportunities provided by smart grid technologies for its electric cooperatives. A smart grid employs innovations like advanced metering, dynamic load control, intelligent switching, and distribution automation to make the grid more efficient and resilient. This makes electric service more reliable and less costly for the people and organizations that depend on it.

To enable smart grid capabilities, electric co-ops must be able to connect numerous devices and systems that automate and control the flow of electricity. Joe points out, “Electric co-ops need more insights and intelligence from the grid, which requires a comprehensive digital network.” This need has evolved to address today’s changing electric grid. And this is where Ericsson comes in.

Koustuv Ghoshal, vice president and head of the utilities and energy business for Ericsson North America, highlights Ericsson’s contribution in this space: “Ericsson’s innovations in cellular technology have not only enabled utilities to reach their full potential, but our dedicated teams of technology experts take pride in helping utilities further harden their grid infrastructure and increase grid safety and reliability to continue to serve their communities.”

Together, NRTC and Ericsson are in a position to bring NRTC members the necessary information and resources to deploy the smart grid capabilities they need to best serve their communities. Ericsson’s partnership will provide NRTC with an Ericsson-designed, private 4G LTE wireless network template, which would be part of a broad hybrid network that can support a new generation of smart grid applications and services. These hybrid networks will

involve multiple technologies including fiber, microwave while leveraging the wide area coverage that private LTE brings complemented with microwave and fiber technologies. Hybrid networks also apply to business models that reduce cost by integrating carrier networks into the private network fabric.

### Bringing true economic benefits to member communities

For NRTC’s member cooperatives, having better network technology is directly linked to enabling more resilient, reliable, and efficient power delivery to households, businesses, and farms. As Joe points out, “More reliable power is not only good for quality of life, but it brings true economic benefits to our communities.”

More reliable power means factories and farms can stay productive, homes and restaurants can keep their perishable foods refrigerated, employees and students can work remotely at home with confidence, and the list goes on. Joe emphasizes, “Economic value is one of the largest benefits that can come from smart grid technologies.”

To that end, the templated private LTE network will be a backbone for advanced digital services provided by NRTC to its members. Joe says, “The Ericsson team came to us with a strong technical roadmap, but just as important they showed a deep understanding of the utility industry and cooperatives in particular. Ericsson’s dedication to the support, growth, and success of rural cooperatives made them the clear choice.”

Koustuv underscores the importance of this partnership: “We know that changing demands on the electric grid are complex issues – especially for rural utility providers – and can be difficult to tackle alone. We believe that partnership sparks creative solutions to reach the farthest ends

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of grid connectivity, and especially with NRTC we want to be that partner for the electric co-op members.”

Importantly, the private LTE network can be customized and deployed by NRTC’s member co-ops to support their own unique applications and use cases. As a result, member co-ops will gain secure long-range wireless connectivity with the capacity to support multiple digital services on a single network platform.

### Making private LTE affordable for small and medium electric cooperatives

Private 4G LTE will provide electric cooperatives in rural and suburban communities with wide area radio network coverage to support a range of smart grid use cases. The key is making the LTE network affordable for NRTC’s members—more than 1,500 utilities and affiliates in 48 states. Some electric co-ops serve only a few thousand meters, directly corresponding to their revenue, compared to hundreds of thousands or millions of meters covered by investor-owned utilities. Further, it doesn’t make economic sense for small electric co-ops to have the technical resources in-house to build a network for smart grid solutions.

Ericsson continues to work with NRTC to figure out ways to reach co-op objectives and make this network affordable to NRTC members. Joe says, “Ericsson is helping us figure out ways to reach our objectives and

make this network affordable for our members.” He refers to the seven principles all cooperatives follow, one of which is grounded in cooperation. “The Ericsson team has lived up to the principle of cooperation left, right, and center.”

### Transforming WKRECC with private LTE

To prove the value of the private LTE network, NRTC engaged one of its member cooperatives—WKRECC—in a trial deployment. NRTC had developed a ten-year technology roadmap for WKRECC, as it does for all its members, showing the potential economic impact from a number of smart grid initiatives. To make those initiatives a reality, however, WKRECC needed a broad digital infrastructure, and the Ericsson solution NRTC presented gave WKRECC confidence to proceed.

Justin McCann, PE, WKRECC’s vice president of engineering, explains, “Our communication network was a hodgepodge of special-purpose systems, each independently operated and maintained. That was becoming problematic when you consider the changes happening in power distribution and the number of endpoint devices on the grid.”

With a sparsely populated service area across a wide geographic region in western Kentucky, running fiber was not economically feasible for WKRECC. Therefore, a 4G LTE wireless network presented an ideal solution to connect more devices and enable more advanced network services.

“Traditional point to multipoint radio systems just can’t handle the demands, but we saw a plethora of use cases for private LTE,” Justin points out. “With private LTE, we’ll have a network that will support multiple smart grid systems for a fraction of what it would cost to expand just one system.”

### Proving the value of private LTE for smart grid use cases

In WKRECC’s trial deployment of the private LTE network, the co-op tested its SCADA systems. SCADA applies to many parts of the transmission and distribution network, with applications ranging from voltage regulators, capacitor banks, and reclosers systems such as fault localization, isolation and service restoration (FLISR), and direct transfer trip (DTT) applications.

SCADA grid application testing during the trial showed the private LTE network achieved field throughput of 13 Mbps download and 5 Mbps upload in 3 MHz bandwidth for Band-8C 900 MHz cell carriers. The network delivered these results with a latency of just 80 milliseconds (less than 5 cycles at 60 Hz) round trip between the WKRECC radio access network in Kentucky and remote Ericsson core servers in Texas.

The capacity of private LTE allows a greater number of data points to be collected from these SCADA applications, providing more precise operational insights from the electric grid and enabling engineers and field crews to respond faster to outages and accelerate recovery times. With that, Justin says, “We’ll have better performance monitoring. We’ll be able to do distribution automation, which will improve reliability and resilience, and enable automatic fault location to accelerate response time when there are outages.”

### Supporting multiple smart grid use cases on a single network

While the trial focused on SCADA, private LTE is capable of carrying multiple applications on one standardized network with security designed in, rather than relying on a multitude of individual proprietary technologies. Utilities can even assign quality of service to different applications on the LTE network, ensuring reliability for mission-critical applications. This opens up a wide range of possible use cases that may also include mission-critical push-to-talk, a more advanced metering infrastructure (AMI), and highly precise geospatial information systems (GIS), among others.

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For example, Justin foresees private LTE enabling WKRECC to take its AMI systems to a higher level of performance. Improved meter-reading cycles will help members take advantage of different time-of-day rates, thus saving members money. This

advancement will also provide WKRECC with more intelligence about grid loads. For example, the WKRECC’s current AMI operates at a system bandwidth of 50 kHz, which means it can communicate with only a handful of meters before getting overwhelmed by the amount of data traffic, thus delaying transmissions. To gather data from all the meters for billing purposes, WKRECC has to stagger the readings and, consequently, meters can be read only every four hours. The private LTE network would provide WKRECC’s AMI system with 3MHz channel bandwidth on which to operate instead of the current 50kHz—a 60 times wider spectrum. This capacity advantage will help improve billing precision and make the outage management system more responsive.

Moreover, higher capacity will allow WKRECC to explore grid edge computing by leveraging AMI for load disaggregation. Load disaggregation will provide WKRECC with additional insights to better address the needs of its customers throughout western Kentucky. More information, such as areas with higher ratios of electric versus gas heaters or where electric vehicle charging stations are being used, can enable WKRECC to provide more data-driven, relevant, and reliable service to the communities it serves.

“Knowing that information comes back to being able to better manage load distribution across the grid,” Justin notes. “It will enable us to look at the implications of changing electrical demands on the grid and help us plan effectively to support those demands for our members and their communities.”

### Achieving far-reaching impact across western Kentucky—and beyond

Justin sees the private LTE having far-reaching impact. For example, another possible use case for WKRECC will be narrow-band IoT for asset monitoring beyond the electric systems. This might include putting sensors on power lines to continuously check impedance or on transformers to monitor their health and alert crews when preventive maintenance is needed, avoiding equipment failures. The private LTE network will also support better mobile communications for line crews, enabling them to use push-to-talk to instantly share information—even videos—from the field to engineers to streamline troubleshooting and improve safety.

Justin even envisions extending the benefits of the private LTE network by segmenting the network for use by other public and private entities in its service area, such as the local sheriff's department, school districts, and farms.

From Ericsson's perspective, Koustuv sees great opportunities to use private LTE to expand access to communication services in rural communities "As the capabilities of the current LTE network evolves in the future to 5G, I do see the possibility of using network slicing techniques to accomplish segmenting the network for specific use cases and customer communities. What better gift can we give to our families and communities than that of opportunity? I am proud that Ericsson is working with NRTC and WKRECC to demonstrate the impact of private LTE networks."

Justin suggests, "We could provide first responders with their own secure, resilient LTE network for mobile communications and GPS tracking to locate the nearest emergency vehicle to an incident. With a private LTE network, schools can provide every student with a laptop or tablet and

give them high-speed access to broadband service, enabling everyone to participate in remote learning regardless of what service they have at home, if any."

Agriculture is an especially important market in western Kentucky, where many farmers have their own SCADA systems to monitor things like electric water pumps and grain bin heaters. Modern farms also have an extensive fleet of GPS-based farm equipment and rely on data communication and analysis for precision agriculture to improve farm production and sustainability. "With equipment across hundreds of acres of farmland, reliable wireless connectivity is a business necessity for our agricultural community," Justin notes.

Additionally, having an advanced, software-upgradeable digital solution like the Ericsson private LTE network will enable WKRECC and other NRTC member cooperatives to pursue other new, innovative smart grid solutions as they emerge. These may include things such as augmented reality to improve line crew safety and efficiency, automated fault isolation and service restoration, dynamic line rating, intelligent voltage

regulation, virtual power plants and distributed generation, and other solutions that have yet to be conceived.

Joe concludes, "There are always going to be new devices and technologies coming along, and investing in our digital network today is key for NRTC to be able to support those capabilities for our members so they can better serve their members. It might be as basic as making sure streetlights are operating to keep people safe at night or automating power redistribution to make sure first responders can communicate and hospitals have power during a natural disaster. But regardless, I have no doubt we will have a positive impact on peoples' lives in the future because of the digital network investments we're making today."

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## Solution Highlights

### Strengthening resilience, reliability, and efficiency of cooperative member power grids

NRTC is enabling suburban and rural electric cooperatives to adopt a wide range of modern smart grid capabilities by providing them an affordable private LTE digital network. This network can support broader network coverage and capacity than would otherwise be feasible with traditional and legacy radio technologies. By leveraging the mature and resilient ecosystem that private LTE brings, together with advanced Ericsson technology, NRTC is enabling its member elective cooperatives to unify once disparate legacy technologies under the umbrella of one secure communications needs today with the ability to seamlessly add use cases in the future.

### Transformational solution

- Enables innovative smart grid capabilities for NRTC's member electric cooperatives, overcoming historical financial and resource limitations

### Ericsson Hardware

- Ericsson Silicon - Ericsson Radio System
- Ericsson Massive MIMO for large-scale 5G network
- Ericsson Radio Access Network (RAN)
- Ericsson Private Networks
- Mission-Critical Communications
- Mission-Critical Push-to-Talk
- Internet of Things Technology

### Ericsson Software

- Ericsson Radio System Software for FDD + TDD spectrum
- Ericsson Radio System Software for mMIMO LTE
- Ericsson Radio System Software NB-IoT
- Ericsson Router 6000 Software
- Ericsson hosted Network Manager Software with CBRS Domain Coordinator
- Ericsson hosted Enterprise Core VNFs
- Ericsson Push-to-Talk Application Software

### Solution advantages

- Single future-proof (4G now but capable of 5G with a software upgrade) network supporting multiple systems for both smart grid use cases and fixed wireless access
- Lower total cost of ownership
- Faster return on investment
- Higher capacity and coverage
- Lower latency potential with future on-premises core solution

## About National Rural Telecommunications Cooperative

National Rural Telecommunications Cooperative (NRTC) is a member-driven cooperative that provides technology solutions to help more than 1,500 electric and telecom members bring all the advantages of today's evolving technology to rural America. NRTC's products and services are developed specifically to meet the needs of rural providers and their customers, and include smart grid and utility solutions, broadband design, engineering, and managed network services and mobile service solutions. [www.nrtc.coop](http://www.nrtc.coop)

## About West Kentucky Rural Electric Cooperative Corporation

West Kentucky Rural Electric Cooperative Corporation, Inc. provides power to more than 31,000 members in western Kentucky. Members of the Cooperative are also the utility's owners. Oversight is provided by a board of directors, elected by the membership and representing each of the Cooperative's four districts. The Cooperative is a Touchstone Energy Cooperative and a distributor of Tennessee Valley Authority power. [www.wkrecc.com](http://www.wkrecc.com)

## About Ericsson

Ericsson enables communications service providers to capture the full value of connectivity. The company's portfolio spans Networks, Digital Services, Managed Services, and Emerging Business, and is designed to help customers go digital, increase efficiency, and find new revenue streams. Ericsson's investments in innovation have delivered the benefits of telephony and mobile broadband to billions of people around the world. The Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York. [www.ericsson.com](http://www.ericsson.com)

